CLAIMS

We claim:

1. A coating composition curable upon exposure to both UV radiation and thermal energy, the composition comprising

(a1) a radiation curable component which polymerizes upon exposure to UV radiation, comprising at least one polymer or oligomer comprising

(a11) at least two functional groups comprising at least one bond activatable upon exposure to UV radiation,

(a2) a thermally curable binder component which polymerizes upon exposure to heat, comprising

(a21) at least two functional groups reactive with functional groups (a3),

(a3) a thermally curable crosslinking component comprising

(a31) two or more functional groups reactive with functional groups (a21), and

(a4) optionally, one or more reactive diluents,

wherein $^{UV}/_{TH}$ is a value between 0.20 to 0.60.

2. The coating composition of claim 2 wherein $^{UV}/_{TH}$ is between 0.25 to 0.50.

3. The coating composition of claim 2 wherein $^{UV}/_{TH}$ is between 0.30 to 0.45.

4. The coating composition of claim 1 wherein the thermally curable component (a2) is selected from the group consisting of polyesters, epoxy functional materials, acrylics, and mixtures thereof.

5. The coating composition of claim 4 wherein thermally curable binder component (a2) comprises two or more isocyanate reactive functional groups (a21) per molecule.

6. The coating composition of claim 5 wherein thermally curable binder component (a2) is a polyester.

7. The coating composition of claim 6 wherein isocyanate-reactive functional groups (a21) are hydroxyl groups.

8. The coating composition of claim 1 wherein radiation curable component (a1) further comprises one or more functional groups (a12) which are reactive to functional groups (a31).

9. The coating composition of claim 8 wherein the ratio of NCO groups to the sum of functional groups (a12) and (a21) is less than 1.30.

10. The coating composition of claim 9 wherein functional groups (a12) and (a21) are isocyanate reactive functional groups and functional groups (a31) are isocyanate groups.

11. The coating composition of claim 10 wherein the ratio of NCO groups to the sum of isocyanate-reactive functional groups (a12) and (a21) is from 0.50 to 1.25.

12. The coating composition of claim 11 wherein the ratio of NCO groups to the sum of isocyanate-reactive functional groups (a12) and (a21) is from 0.75 to 1.10.

13. The coating composition of claim 12 wherein the ratio of NCO groups to the sum of isocyanate-reactive functional groups (a12) and (a21) is less than 1.00.

14. The coating composition of claim 13 wherein the ratio of NCO groups to the sum of isocyanate-reactive functional groups (a12) and (a21) is from 0.75 to 1.00.

15. The coating composition of claim 1 wherein thermally curable binder component (a2) comprises less than 5% by weight of aromatic ring moieties, based on the nonvolatile weight of thermally curable binder component (a2)

16. The coating composition of claim 15 wherein thermally curable binder component (a2) has no more than 2% by weight of aromatic ring moieties, based on the nonvolatile weight of thermally curable binder component (a2).

17. The coating composition of claim 16 wherein thermally curable binder component (a2) has between 0 to less than 2% by weight of aromatic ring moieties, based on the nonvolatile weight of thermally curable binder component (a2).

18. The coating composition of claim 1 wherein the thermally curable component (a2) has a polydispersity of less than 4.0.

19. The coating composition of claim 18 wherein the thermally curable component (a2) has a polydispersity of less than 3.5.

20. The coating composition of claim 19 wherein the thermally curable component (a2) has a polydispersity of from 1.5 to less than 3.5.

21. The coating composition of claim 20 wherein the thermally curable component (a2) has a polydispersity of from 1.75 to less than 3.0.

22. A method of making a coated substrate, comprising applying the coating composition of claim 1 to a substrate to provide a coated substrate.

23. The method of claim 22 further comprising subjecting the coated substrate to UV radiation to provide a UV cured coated substrate.

24. The method of claim 23 further comprising subjecting the UV cured coated substrate to heat to provide a UV and thermally cured coated substrate.

25. The method of claim 22 wherein the substrate comprises a plastic.

26. The method of claim 25 wherein the plastic substrate is a fiber-reinforced plastic substrate.

27. The method of claim 25 wherein the plastic substrate is SMC or BMC.

28. The method of claim 24 wherein the UV and thermally cured coated substrate is coated with one or more coating compositions to provide a coated UV and thermally cured coated substrate.

29. The method of claim 28 wherein the UV and thermally cured coated substrate is coated with at least one basecoat coating composition.

30. The method of claim 28 wherein the UV and thermally cured coated substrate is coated with at least one clearcoat coating composition.

31. The method of claim 28 wherein the coated UV and thermally cured coated substrate is substantially free of surface defects resulting from vaporous substrate emissions.

32. A coated substrate made by the method of claim 22.